CLAIMS

1. A security document or device comprising:

a substrate including at least one layer of polymeric material:

an optical component formed by at least one orientating layer and at least one liquid crystal polymer (LCP) layer in contact with the orientating layer; and

an intermediate layer provided between the optical component and the substrate which improves the adhesion of the optical component to the substrate.

2. A security document or device according to claim 1 wherein the intermediate layer comprises a primer layer.

3. A security document or device according to claim 2 wherein the primer layer includes a hydroxyl terminated polymer.

4. A security document or device according to claim 2 or claim 3 wherein primer layer includes a primer selected from the group of:

hydroxyl terminated polyester based co-polymers; or
polyethyleneimine; or
cross-linked hydroxylated acrylates; or
uncross-linked hydroxylated acrylates; or
polyurethanes; or
UV-curing anionic acrylates: or
UV-curing cationic acrylates.

5. A security document or device according to any one of claims 2 to 4 wherein the primer layer includes a cross-linker.

6 A security document or device according to claim 5 wherein the cross-linker is a multifunctional isocyanate.

7 A security document or device according to claim 5 or claim 6 wherein the cross-linker is selected from the group comprising:

isocyanates; or

polyaziridines; or
ziconium complexes; or
aluminium acetylacetone; or
melamines; or
carbodi-imides.

8. A security document or device according to any one of claims 2 to 7 wherein the primer layer does not substantially affect the alignment of the orientating layer.

9. A security document or device according to any one of claims 1 to 8 wherein the substrate is formed from a polymeric material.

10. A security document or device according to any one of claims 1 to 9 wherein the substrate includes at least one base layer of biaxially oriented polymeric material.

11. A security document or device according to claim 10 wherein the substrate includes one or more co-polymer layers on one or both sides of the base layer of biaxially oriented polymeric material.

12. A security document or device according to claim 10 wherein the substrate comprises a base layer of paper with at least one polymeric coating provided on one or both sides of the base layer.

13. A security document or device according to any one of claims 1 to 11 wherein the substrate has a base layer formed from a transparent material.

14. A security document or device according to any one of claims 10 to 13 wherein the substrate further includes at least one opacifying coating applied on at least one side of the base layer.

15. A security document or device according to claim 14 wherein at least one opacifying coating is applied on both sides of the base layer.

16. A security document or device according to either claim 14 or claim 15 wherein the at least one opacifying coating contains at least one opacifying pigment.

17. A security document or device according to claim 16 wherein the opacifying coatings comprise a major proportion of one or more opacifying pigments bound with a minor proportion of a cross-linkable polymeric binder.

18. A security document or device according to either claim 16 or claim 17 wherein the opacifying pigment or pigments are selected from the group including:

titanium dioxide (TiO_2); or
calcium carbonate ($CaCO_3$); or
barium sulphate ($BaSO_4$); or
zinc oxide (ZnO).

19. A security document or device according to any one of claims 14 to 18 wherein one or more layers of printed indicia are provided on the opacifying layers.

20. A security document or device according to any one of claims 13 to 19 the at least one opacifying coating completely covers the surface of the transparent substrate.

21. A security document or device according to any one of claims 13 to 19 wherein the at least one opacifying coating partially covers the transparent substrate so as to form a transparent portion or window which is not covered by the opacifying coating.

22. A security document or device according to any one of claims 13 to 19 wherein the at least one opacifying coating partially covers the transparent substrate so as to form two transparent portions or windows which are not covered by the opacifying coating.

23. A security document or device according to any one of claims 1 to 22 wherein the orientating layer and the liquid crystal polymer layer cover the entire surface of the substrate.

24. A security document or device according to any one of claims 1 to 22 wherein the orientating layer and the LCP layer are applied over a selected region or regions of the substrate.

25. A security document or device according to claim 21 or claim 22 wherein the orientating layer and the LCP layer are applied wholly within the area of the window or windows.

26. A security document or device according to claim 21 or claim 22 wherein the orientating layer and the LCP layer are applied partially within and partially outside the area of the window or windows.

27. A security document or device according to claim 21 or claim 22 wherein the orientating layer and the LCP layer are applied wholly outside the window or windows.

28. A security document or device according to any one of claims 1 to 27 wherein the orientating layer is in intimate contact with the LCP layer.

29. A security document or device according to any one of claims 1 to 28 wherein the orientating layer comprises a photo-alignment layer.

30. A security document or device according to claim 29 wherein the photo-alignment layer is a photo-orientated polymer network (PPN).

31. A security document or device according to any one of claims 1 to 28 wherein the orientating layer comprises a polyimide layer rubbed in one direction.

32. A security document or device according to any one of claims 1 to 28 wherein the orientating layer comprises a layer having an orientating effect obtained by oblique sputtering with SiO_x.

33. A security document or device according to any one of claims 1 to 32 wherein a photo-orientated polymer network is applied to an orientating layer deposited on the substrate.

34. A security document or device according to any one of claims 1 to 33 wherein the LCP layer comprises an anisotropic layer of orientated cross-linked liquid crystal monomers.

35. A security document or device according to any one of claims 1 to 34 wherein molecules of the LCP layer have an orientation determined by the orientation of the underlying orientating layer.

36. A security document or device according to any one of claims 1 to 34 wherein molecules of the LCP layer have an orientation transferred from the orientating layer to the LCP layer.

37. A security document or device according to claim 34 wherein the LCP layer is photo-cross-linked by the action of light of a suitable wavelength and retains the orientation of molecules predetermined by the orientating layer.

38. A security document or device according to any one of claims 1 to 37 including further orientating layers and/or LCP layers.

39. A security document or device according to claim 38 wherein the security device includes a second orientating layer on the first LCP layer.

40. A security document or device according to claim 39 wherein the security device includes a second LCP layer on the second orientating layer.

41. A security document or device according to either claim 39 or claim 40 wherein the second orientating layer comprises a photo-orientated polymer network.

42. A security document or device according to any one of claims 38 to 41 wherein two or more orientating layers and LCP layers having different orientation patterns are provided to form a stack of orientation layers and LCP layers on a substrate.

43. A security document or device according to any one of claims 1 to 42 further including a reflector layer.

44. A security document or device according to claim 43 wherein the reflector layer is a reflective metallic layer.

45. A security document or device according to any one of claims 1 to 42 further including a polarizing layer.

46. A security document or device according to claim 45 wherein the polarising layer is a photo oriented polymer network (PPN) with a liquid crystal polymer (LCP) and a cross-linked dichroic dye added to form the polariser.

47. A security document or device according to claim 45 or claim 46 wherein the polarising layer is a linear polarizer.

48. A security document or device according to any one of claims 43 to 47 wherein the linear polarizer is located between the orientation layer and the substrate.

49. A security document or device according to any one of the preceding claims wherein the optical component formed by the combination of the LCP layer(s) and orientation layer(s) contains at least one hidden image.

50. A security document or device according to claim 49 wherein the hidden image is successively revealed and concealed when the optical component is held between two polarizers and one of the polarizers is rotated.

51. A security document according to claim 43 or claim 44 wherein the optical component is provided at a first location with a reflector or polarizing layer and a polariser is provided in a window at a second, laterally spaced location so that the security document is self-authenticating by folding the document to bring the windows into register.

52. A security device according to any one of claims 1 to 50 wherein the device is adapted for attachment to another article.

53. A method of manufacturing a security document or device comprising:

providing a substrate which includes at least one layer of polymeric material;

applying a primer layer on at least one side of the substrate;

applying an orientating layer over the prime layer;

aligning the molecules of the orientating layer; and

applying a liquid crystal polymer (LCP) layer over the orientating layer.

54. A method according to claim 53 wherein the step of applying the primer layer is performed by applying a primer including a polymer component and a cross-linker.

55. A method according to claim 43 wherein the primer includes a hydroxyl terminated polymer.

56. A method according to claim 54 or claim 55 wherein the cross-linker is a multifunctional isocyanate.

57. A method according to any one of claims 53 to 56 wherein the step of applying the orientating layer over the primer layer is performed by applying a

solution containing a photo orientating polymer network (PPN) over the primer layer.

58. A method according to claim 57 further including the step of drying the substrate to remove solvent from the PPN solution wherein a strong adhesive bond is formed between the orientating layer and the substrate.

59. A method according to any one of claims 53 to 58 wherein the orientating layer includes a photoalignment layer and further including the step of exposing the photoalignment layer to polarized light to align the molecules of the photoalignment layer.

60. A method according to claim 59 wherein the photoalignment layer is subjected to a first exposure of polarized light through a mask to form local regions having a first orientation of molecules.

61. A method according to claim 60 wherein the photoalignment layer is subjected to a second exposure without a mask using a different component of the polarized light to form local regions having a second orientation to form an orientation pattern in the orientating layer.

62. A method according to claim 59 wherein an orientation pattern is formed in the photoalignment layer and/or the LCP layer without the use of a mask.

63. A method according to claim 62 wherein the orientation pattern is formed by a variable printing process.

64. A method according to claim 62 wherein the orientation pattern is formed by a laser writing process.

65. A method according to any one of claims 53 to 64 wherein the LCP layer is formed by applying a coating of liquid crystal monomers to the orientating layer such that the liquid crystal molecules assume the orientation of the molecules of

the underlying orientating layer, and cross linking the monomers to fix the orientation of the liquid crystal molecules.

66. A method according to claim 65 further including the step of applying a second orientating layer on the LCP layer.

67. A method according to claim 66 further including the step of applying a second LCP layer on the second orientating layer in a similar manner as the first orientating layer is applied to the primer layer on the substrate.

68. A method according to claim 67 wherein the second orientating layer is exposed to linear polarized light through a mask having a different pattern to the mask used to produce the orientation pattern in the first orientating layer to produce a different orientation pattern in the second orientating layer.